REMARKS

Amendments are being made to claims 5, 10 and 12-14 to remove their multiple dependencies.

Please proceed to examine the application as amended herein.

Respectfully submitted,
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Amended Claims - Marked-Up Version

--5. (Amended) A method according to [one of claims 1] claim 1, characterized in that the steel comprises (in mass %)

C: 0.25 – 1.05 %;

Si: ≤ 0.25 %;

Mn: ≤ 0. 6 %;

–in that the hot strip (W) after finish rolling in the first cooling phase (t_{CK})of accelerated cooling starting from a temperature above 800 °C, is cooled to a temperature of between 530 and 620 °C;

–in that the hot strip (W) in the second cooling phase (t_{LK}) of accelerated cooling is cooled to a temperature of less than 500 °C; and

–in that the hot strip (W) is subsequently coiled.

--10. (Amended) A method according to [one of the preceding claims] claim 1, characterized in that between the first cooling phase (t_{CK}) of accelerated cooling and the second cooling phase (t_{LK}) of accelerated cooling the hot strip (W) passes through an intermediate cooling phase (t_{PAUSE}) during which the hot strip (W) is subjected to cooling by exposure to air.

--12. (Amended) A method according to [one of the preceding claims] claim 1, characterized in that the first cooling phase (t_{CK}) of accelerated cooling starts at the latest two seconds after the last pass of finish rolling.

--13. (Amended) A method according [one of the preceding claims] claim 1, characterized in that at least one of the passes during finish rolling is carried out in the austenitic range below a temperature of Ar3 + 80 °C, and in that an overall pass reduction during finish rolling exceeding 30 % is achieved..

--14. (Amended) A method according to [one of the preceding claims] claim 1, characterized in that in the second cooling phase (t_{LK}) of accelerated cooling the hot strip (W) is cooled at a cooling rate of at least 30 °C/s.

PENDING CLAIMS

1. A method for producing a hot strip (W) which strip is produced in particular from continuous casting in the shape of reheated slabs or slabs obtained directly from the casting heat, from thin slabs or cast strip, based on a steel comprising (in mass %)

C:	0.001 – 1.05 %;
Si:	≤ 1.5 %;
Mn:	0.05 – 3.5 %;
Al:	≤ 2.5%;

as well as optionally one or several of the following constituents

- Cu, Ni, Mo with an amount of ≤ 0.8 %;
- N, Ti, Nb, V, Zn, B with an amount of ≤ 0.5 %;
- P with an amount of ≤ 0.09 %;
- Cr with an amount of ≤ 1.5 %; and /or
- S with an amount of ≤ 0.02%;

and

the remainder being iron as well as the usual accompanying elements,

with the steel also optionally having been treated in the liquid phase with Ca or Ca carrier alloys,

involving the following steps:

- continuous finish rolling of the hot strip (W);
- continuous cooling of the hot strip (W) in at least two subsequent cooling phases (t_{CK}, t_{LK}) of accelerated cooling, to a final temperature;

- with the first cooling phase of (t_{CK}) of accelerated cooling starting at the latest three seconds after the last pass of finish rolling; and

- with the hot strip (W) during the first cooling phase (t_{CK}) of accelerated cooling rate of at least 250 °C/s.

2. A method according to claim 1, characterized in that the steel comprises 0.005 to 0.4 mass % of silicon.

3. A method according to claim 1, characterized in that

- the steel comprises (in mass %)

C:	≤ 0.07 %;
Si:	≤ 0.2%;
Mn:	≤ 0.6 %;
Al:	≤ 0.08%;

- in that the hot strip (W) during finish rolling is rolled in the austenitic area;

- in that the hot strip (W) in the first cooling phase (t_{CK}) of accelerated cooling starting at a temperature above 850 °C is cooled to a temperature of 680 to 750 °C;

- in that the hot strip (W) in the second cooling phase (t_{LK}) of accelerated cooling is cooled to a temperature of less than 600 °C; and

- in that the hot strip (W) is subsequently coiled.

4. A method according to claim 1, characterized in that the steel (in mass %) comprises

C:	0.04 – 0.09 %;
Si:	≤ 0.2 %;
Mn:	0.5 – 2.0 %;
P:	0.02 – 0.09 %;
Cr:	≤ 0.9 %.

– in that the hot strip (W) after finish rolling in the first cooling phase (t_{CK}) of accelerated cooling starting from a temperature of about 800 °C, is cooled to a temperature of 650 to 730 °C;

– in that in the second cooling phase (t_{LK}) of accelerated cooling, the hot strip (W) is cooled to less than 500 °C; and

– in that the hot strip (W) is subsequently coiled.

5. A method according to claim 1, characterized in that the steel comprises (in mass %)

C: 0.25 – 1.05 %;
Si: ≤ 0.25 %;
Mn: ≤ 0.6 %;

– in that the hot strip (W) after finish rolling in the first cooling phase (t_{CK}) of accelerated cooling starting from a temperature of about 800 °C, is cooled to a temperature of between 530 and 620 °C;

– in that the hot strip (W) in the second cooling phase (t_{LK}) of accelerated cooling is cooled to less than 500 °C; and

– in that the hot strip (W) is subsequently coiled.

6. A method according to claim 1, characterized in that the steel comprises (in mass %)

C: 0.12 – 0.3 %;
Mn: 1.2 ≤ 3.5 %;
Al: 1.1 ≤ 2.2 %;

– in that the hot strip (W) after finish rolling in the first cooling phase (t_{CK}) of accelerated cooling starting from a temperature between the Ar_3 temperature and a temperature of Ar_3 + 150 °C, is cooled to a temperature which is up to 50 °C below the Ar_3 temperature;

- in that the hot strip (W) in the second cooling phase (t_{LK}) of accelerated cooling is cooled to 350 to 550 °C; and

- in that the hot strip (W) is subsequently coiled.

7. A method according to claim 1, characterized in that the steel comprises (in mass %)

C:	0.04 – 0.09 %;
Si:	0.5 – 1.5 %;
Mn:	0.5 – 2.0 %;
Al:	0.4 – 2.5 %;
P:	≤ 0.09 %;
Cr:	≤ 0.9 %.

- in that the hot strip (W) after finish rolling in the first cooling phase (t_{CK}) of accelerated cooling starting from a temperature above 800 °C, is cooled to a temperature of between 650 and 730 °C;

- in that the hot strip (W) in the second cooling phase (t_{LK}) of accelerated cooling is cooled to a temperature of less than 500 °C; and

- in that the hot strip (W) is subsequently coiled.

8. A method according to claim 1, characterized in that the steel comprises (in mass %)

C:	0.07 % – 0.22 %;
Si:	0.1 – 0.45 %
Mn:	0.2 % – 1.5 %;

- in that the hot strip (W) after finish rolling in the first cooling phase (t_{CK}) of accelerated cooling starting from a temperature above 800 °C, is cooled to a temperature of between 650 and 730 °C;

- in that the hot strip (W) in the second cooling phase (t_{LK}) of accelerated cooling is cooled to a temperature of less than 500 °C; and

– in that the hot strip (W) is subsequently coiled.

9. A method according to claim 1, characterized in that the steel comprises (in mass %)

C: 0.07 % – 0.22 %;

Si: 0.1 – 0.45 %

Mn: 0.2 % – 1.5 %;

– in that the hot strip (W) after finish rolling in the first cooling phase (t_{CK}) of accelerated cooling starting from a temperature above 800 °C, is cooled to a temperature of between 580 and 650 °C;

– in that the hot strip (W) in the second cooling phase (t_{LK}) of accelerated cooling is cooled to a temperature of less than 500 °C; and

– in that the hot strip (W) is subsequently coiled.

10. A method according to claim 1, characterized in that between the first cooling phase (t_{CK}) of accelerated cooling and the second cooling phase (t_{LK}) of accelerated cooling the hot strip (W) passes through an intermediate cooling phase (t_{PAUSE}) during which the hot strip (W) is subjected to cooling by exposure to air.

11. A method according to claim 10, characterized in that the intermediate cooling phase (t_{PAUSE}) lasts for at least one second.

12. A method according to claim 1, characterized in that the first cooling phase (t_{CK}) of accelerated cooling starts at the latest two seconds after the last pass of finish rolling.

13. A method according to claim 1, characterized in that at least one of the passes during finish rolling is carried out in the austenitic range below a temperature of Ar_3 + 80 °C, and in that an overall pass reduction during finish rolling exceeding 30% is achieved.

14. A method according to claim 1, characterized in that in the second cooling phase (t_{LK}) of accelerated cooling the hot strip (W) is cooled at a cooling rate of at least 30 °C/s.

<u>In advance by fax</u>

European Patent Office
Erhardstr. 27
80331 Munich

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International patent application PCT/EP00/01517
Thyssen Krupp Stahl AG

Concerning the written decision of 11 October 2000.

1) Amended documents

Please find enclosed amended claims 1 to 14.

The characteristics of the original claims 2 and 15 as well as the characteristic contained in the original claim 13, namely that the cooling rate in the first stage exceeds 250 °C, have been incorporated in amended claim 1. From the point of view of contents, the amended claims 2 to 11 correspond to the original claims 3 to 12; they were merely adapted because of the removal of claim 2. The amended claim 12 now only contains the first characteristic stated in the original claim 13. The amended claims 13 and 14 correspond to the original claims 14 and 16.

The great importance per se, of the high cooling rate of 250 °C/s is evident not only from the respective explanations in the first paragraph of page 8 of the description, but also from the explanations starting on the

bottom of page 10 where examples of the respectively selected cooling rates are described. In particular at this latter position, an explanation is provided that as a result of cooling at a rate of 250 °C/s and above, in the first phase of cooling, the γ/α transformation of the hot strip steel is suppressed, irrespective of any concrete time within which this compact cooling has to take place. It is thus clear that the cooling rate of more than 250 °C/s in itself is a significant characteristic of the invention.

The objection relating to clarity (item VIII of the written decision) has been satisfied by incorporating the characteristics of the original claims 2 and 15 in the amended claim 1.

2) Patentability of the invention

Now that it has been clarified that according to the invention the cooling rate in the first stage of cooling has to be at least 250 °C/s, the novelty of the invention claimed when compared to the state of the art cited against, has been demonstrated.

As has been mentioned by the Examination Office itself, only D1, JP 10 195588 A has provided examples which show that it might be advantageous to carry out cooling in two stages, with the cooling rate in the first stage exceeding 150 °C/s. Such high cooling rates are however achieved only, in that relatively thin hot strip is being processed. Thus the highest cooling rates have only been achieved with extremely thin hot strip (Table 2, example 18: hot strip thickness = 0.8 mm, cooling rate = 200 °C/s; example 17: hot strip thickness = 1.4 mm, cooling rate = 180 °C/s).

Furthermore, the sense of the instruction stated in D1, according to which the hot strip in the first stage is to be cooled at a rate of at least 150 °C/s, does not become clear from D1. But rather there is only a general instruction stating that the cooling rate is to be in excess of 50 °C. With cooling rates of 50 °C to less than 250 °C, in the case of steels of the type at issue, suppression of the γ/α transformation which forms part of the aim of the invention, is however not achieved with the required degree of safety.

But rather, D1 leaves it up to the person skilled in the art, to select any cooling rate above 50 °C/s in the first cooling phase. It was therefore not possible to glean from D1 the effect achieved by the present invention, namely targeted safe suppression of the γ/α transformation, right down to low temperatures. Said effect of the present invention was therefore a surprise to the person skilled in the art.

The examples mentioned in all other citations, all mention cooling rates for the first stage of cooling which are significantly lower than the necessary minimum of 150 °C/s according to the original claim 1, or the 200 °C/s known from D1. Thus the state of the art described in these documents is more remote than that known from D1.

It is thus important to grasp the fact that by stating a minimum limit for a cooling rate, which minimum limit is far above the minimum limit known from examples from the state of the art, a teaching has been created which has led to an effect which could not have been anticipated. The teaching of the invention is thus new.

The teaching of the invention is also inventive, because, as has already been explained, even the nearest state of the art, which is unquestionably the one published in D1, has not supplied any indication that the γ/α transformation in the case of steels at issue in this context, can effectively be influenced by a sufficient cooling rate, to the extent that a tough hot strip with good formability is obtained. Even taking into account the state of the art contained in the citations, a person skilled in the art would have failed in meeting the object that has been met by the inventor. This object consisted of providing a method for producing hot strip of very considerable forming ability and high strength, with such a strip being able to be safely produced with the degree of repeatability required in practical operation.

Thus the teachings claimed meet all the requirements of a patentable invention. We request that taking into account the arguments presented above, an international preliminary patent report be issued which recognises the patentability of the invention claimed.

So as to keep the cost of the process to a minimum, adaptation of the description to the amended claims and to the cited state of the art will be delayed until such time as the national / regional phases of the PCT application have been initiated.

Patent Attorney

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<u>Enclosure:</u> Amended claims 1 to 14